

What is claimed is:

1. A radio communication device adapted to radio communications using a predetermined frequency band, said device comprising:

an information signal detection means for detecting an information signal transmitted from some other radio communication device;

an idle signal transmission means for transmitting an idle signal, notifying other radio communication devices of the idle state of said predetermined frequency band of non-detection of an information signal transmitted from some other radio communication device as detected by said information signal detection means;

an interference wave signal detection means for detecting any interference wave signal being transmitted by way of said predetermined frequency band; and

said idle signal transmission means being adapted to avoid transmission of said idle signal upon detection of an interference wave signal.

2. A radio communication device adapted to radio communications using a predetermined frequency band, said device comprising:

an information signal detection means for detecting an information signal transmitted from some other radio communication device;

an idle signal transmission means for transmitting an idle signal, notifying other radio communication devices of the idle state of said predetermined frequency band of non-detection of an information signal transmitted from some other radio communication device as detected by said information signal detection means;

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an interference wave signal detection means for detecting any interference wave signal being transmitted by way of said predetermined frequency band;

an interference wave signal transmission pattern estimation means for estimating the temporal pattern of transmission of the interference wave signal as detected by said interference wave signal detection means; and

said idle signal transmission means being adapted to computationally determine the timing for the idle signal and the information signal transmitted from some other radio communication device in response to said idle signal not overlapping the (time of) transmission of said interference wave signal and transmit said idle signal at the computationally determined timing.

3. The radio communication device according to claim 2, wherein said interference wave signal detection means detects any interference wave signal before the start of operation of the device.

4. The radio communication device according to claim 2, wherein said interference wave signal detection means detects any interference wave signal at regular intervals during the operation of the device.

5. The radio communication device according to claim 2, wherein said interference wave signal detection means detects any interference wave signal during the device is not operating for communications.

6. The radio communication device according to claim 2, wherein, when an interference wave signal is detected, said idle signal transmission

means avoids the transmission of said idle signal and computationally determines the timing for the idle signal and the information signal to be transmitted from some other radio communication device in response to the idle signal not overlapping the transmission period of said interference wave signal so as to transmit said idle signal at the determined timing.

7. A radio communication device adapted to radio communications using a predetermined frequency band, said device comprising:

an information signal detection means for detecting an information signal transmitted from some other radio communication device;

an idle signal transmission means for transmitting an idle signal, notifying other radio communication devices of the idle state of said predetermined frequency band of non-detection of an information signal transmitted from some other radio communication device as detected by said information signal detection means;

an interference wave signal detection means for detecting the signal level any interference wave signal being transmitted by way of said predetermined frequency band; and

said idle signal transmission means being adapted to transmit said idle signal by containing therein level information indicating the signal level of said interference wave signal.

8. A radio communication device adapted to radio communications using a predetermined frequency band, said device comprising:

an information signal detection means for detecting an information signal transmitted from some other radio communication device;

an idle signal transmission means for transmitting an idle signal, notifying other radio communication devices of the idle state of said predetermined frequency band of non-detection of an information signal transmitted from some other radio communication device as detected by said information signal detection means;

an interference wave signal detection means for detecting any interference wave signal being transmitted by way of said predetermined frequency band;

an interference wave signal transmission pattern estimation means for estimating the temporal pattern of transmission of the interference wave signal as detected by said interference wave signal detection means; and

said idle signal transmission means being adapted to transmit said idle signal by containing therein time length information indicating the time length available for forwarding the transmission of said information signal from some other radio communication means as transmitted in response to said idle signal without overlapping with the interference wave signal, if any, on the basis of the pattern estimated by said interference wave signal transmission pattern estimation means.

9. A radio communication device adapted to radio communications using a predetermined frequency band, said device comprising:

an idle signal reception means for receiving an idle signal transmitted from some other radio communication device and indicating the availability of said

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predetermined frequency range;

an information signal transmission means for transmitting an information signal to said some other radio communication means having transmitted said idle signal according to the timing of receiving said idle signal;

    said idle signal containing level information indicating the signal level of any interference wave signal being transmitted by way of said predetermined frequency range; and

    said information signal transmission means being adapted to transmit said information signal to its base station, indicating the detectable signal level as determined on the basis of said signal level of the interference wave signal.

10. A radio communication device adapted to radio communications using a predetermined frequency band, said device comprising:

    an idle signal reception means for receiving an idle signal transmitted from some other radio communication device and indicating the availability of said predetermined frequency range;

    an information signal transmission means for transmitting an information signal to said some other radio communication means having transmitted said idle signal according to the timing of receiving said idle signal;

    said idle signal containing time length information indicating the time length available for signal transmission without overlapping with the interference wave signal, if any, being transmitted by way of said predetermined frequency range; and

said information signal transmission means being adapted to transmit an information signal on the time length available for signal transmission directed to its base station as determined on the basis of said time length information.

11. A radio communication system comprising a base station and one or more than one terminal communication devices for radio communications between said base station and said one or more than one terminal communication devices, using a predetermined frequency band;

said base station having:

an information signal detection means for detecting an information signal transmitted from said terminal communication device or any of said terminal communication devices;

an idle signal transmission means for transmitting an idle signal, notifying said one or more than one other terminal communication devices of the idle state of said predetermined frequency band of non-detection of an information signal transmitted from said terminal communication device or any of said terminal communication devices as detected by said information signal detection means;

an interference wave signal detection means for detecting any interference wave signal being transmitted by way of said predetermined frequency band;

said idle signal transmission means being adapted to avoid transmission of said idle signal upon detection of an interference wave signal; and

said terminal communication device or each of said terminal communication

devices being adapted to transmit an information signal according to the timing of receiving said idle signal transmitted from said base station.

12. A radio communication system comprising a base station and one or more than one terminal communication devices for radio communications between said base station and said one or more than one terminal communication devices, using a predetermined frequency band;

    said base station having:

        an information signal detection means for detecting an information signal transmitted from said terminal communication device or any of said terminal communication devices;

        an idle signal transmission means for transmitting an idle signal, notifying said one or more than one other terminal communication devices of the idle state of said predetermined frequency band of non-detection of an information signal transmitted from said terminal communication device or any of said terminal communication devices as detected by said information signal detection means;

        an interference wave signal detection means for detecting the level of any interference wave signal being transmitted by way of said predetermined frequency band;

        an interference wave signal transmission pattern estimation means for estimating the temporal pattern of transmission of the interference wave signal as detected by said interference wave signal detection means;

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said idle signal transmission means being adapted to computationally determine the timing for the idle signal and the information signal transmitted from said terminal communication device or any of said terminal communication devices in response to said idle signal not overlapping the (time of) transmission of said interference wave signal on the basis of the pattern estimated by said interference wave signal transmission pattern estimation means and transmit said idle signal at the computationally determined timing; and

said terminal communication device or each of said terminal communication devices being adapted to transmit an information signal to said base station according to the timing of receiving said idle signal transmitted from said base station.

13. A radio communication system comprising a base station and one ore more than one terminal communication devices for radio communications between said base station and said one or more than one terminal communication devices, using a predetermined frequency band;

said base station having:

an information signal detection means for detecting an information signal transmitted from said terminal communication device or any of said terminal communication devices;

an idle signal transmission means for transmitting an idle signal, notifying said one or more than one other terminal communication devices of the idle state of said predetermined frequency band of non-detection of an information signal transmitted

from said terminal communication device or any of said terminal communication devices as detected by said information signal detection means;

an interference wave signal detection means for detecting the level of any interference wave signal being transmitted by way of said predetermined frequency band;

said idle signal transmission means being adapted to transmit said idle signal by containing therein level information indicating the signal level of said detected interference wave signal; and

said terminal communication device or each of said terminal communication devices being adapted to transmit an information signal on the detectable signal level to said base station according to the timing of receiving said idle signal transmitted from said base station and the level information contained in said idle signal.

14. A radio communication system comprising a base station and one ore more than one terminal communication devices for radio communications between said base station and said one or more than one terminal communication devices, using a predetermined frequency band;

said base station having:

an information signal detection means for detecting an information signal transmitted from said terminal communication device or any of said terminal communication devices;

an idle signal transmission means for transmitting an idle signal, notifying said

one or more than one other terminal communication devices of the idle state of said predetermined frequency band of non-detection of an information signal transmitted from said terminal communication device or any of said terminal communication devices as detected by said information signal detection means;

an interference wave signal detection means for detecting the level of any interference wave signal being transmitted by way of said predetermined frequency band;

an interference wave signal transmission pattern estimation means for estimating the temporal pattern of transmission of the interference wave signal as detected by said interference wave signal detection means;

said idle signal transmission means being adapted to transmit said idle signal by containing therein time length information indicating the time length available for forwarding the transmission of said information signal from said terminal communication device or any of said terminal communication devices as transmitted in response to said idle signal without overlapping with the interference wave signal, if any, on the basis of the pattern estimated by said interference wave signal transmission pattern estimation means; and

said terminal communication device or each of said terminal communication devices being adapted to transmit an information signal on the time length available for signal transmission to the base station according to the timing of receiving said idle signal transmitted from said base station and the time length information contained in

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said idle signal.

15. A radio communication method for radio communications between a base station and one or more than one terminal communication devices, using a predetermined frequency band;

    said base station detecting any interference wave signal being transmitted by way of said predetermined frequency band;

    said base station transmitting an idle signal to said one or more than one other terminal communication devices, notifying the availability of said predetermined frequency band, avoiding said detected interference wave signal, if any; and

    said terminal communication device or each of said terminal communication devices transmitting an information signal according to the timing of receiving said idle signal transmitted from said base station.

16. A radio communication method for radio communications between a base station and one or more than one terminal communication devices, using a predetermined frequency band;

    said base station detecting any interference wave signal being transmitted by way of said predetermined frequency band;

    said base station estimating the temporal pattern of transmission of the detected interference wave signal, if any, on the basis of said interference wave signal;

    said base station computationally determining the timing for the idle signal and the information signal transmitted from said terminal communication device or any of

said terminal communication devices in response to said idle signal not overlapping the (time of) transmission of said interference wave signal on the basis of the estimated pattern and transmitting said idle signal at the computationally determined timing; and

    said terminal communication device or each of said terminal communication devices transmitting an information signal to said base station according to the timing of receiving said idle signal transmitted from said base station.

17. A radio communication method for radio communications between a base station and one or more than one terminal communication devices, using a predetermined frequency band;

    said base station detecting the level of any interference wave signal being transmitted by way of said predetermined frequency band;

    said base station transmitting an idle signal, containing therein level information indicating the signal level of the detected interference wave signal, if any, to said one or more than one terminal communication devices; and

    said terminal communication device or each of said terminal communication devices transmitting an information signal on the detectable signal level to said base station according to the timing of receiving said idle signal and the level information contained in said idle signal.

18. A radio communication method for radio communications between a base station and one or more than one terminal communication devices, using a

predetermined frequency band;

    said base station detecting any interference wave signal being transmitted by way of said predetermined frequency band;

    said base station estimating the temporal pattern of transmission of the interference wave signal, if any, as detected by said interference wave signal detection means;

    said base station transmitting an idle signal, containing the time length information indicating the available time length of said predetermined frequency band for forwarding the transmission of an information signal from said terminal communication device or any of said terminal communication devices without overlapping with the interference wave signal, if any, on the basis of the estimated pattern to said terminal component device; and

    said terminal communication device or each of said terminal communication devices transmitting an information signal on the time length available for signal transmission to the base station according to the timing of receiving said idle signal and the time length information contained in said idle signal.

19. A radio communication device adapted to radio communications using a plurality of frequency channels, said device comprising:

    an information signal detection means for detecting an information signal transmitted from some other radio communication device;

    an idle signal transmission means for transmitting an idle signal by using one

of said plurality of frequency channels for notifying said some other radio communication device of the availability of said frequency channel; and

an interference wave signal detection means for detecting any interference wave signal being transmitted by way of any of said frequency channels; and said idle signal transmission means being adapted to transmit said idle signal, using a frequency channel free from the detected interference wave signals, if any.

20. The radio communication device according to claim 19, wherein said idle signal transmission means contains channel limiting information for limiting the frequency channels that can be used for transmitting an idle signal out of said plurality of frequency channels in said idle signal.

21. The radio communication device according to claim 19, further comprising:  
an interference wave signal transmission pattern estimation means for estimating the temporal pattern of transmission of an interference wave signal on each of the frequency channels; and

said idle signal transmission means switches the frequency channel for the transmission of said idle signal on the estimated pattern so as to make said idle signal and the information signal transmitted from said some other radio communication device in response to said idle signal not overlap the transmission of said interference wave.

22. The radio communication device according to claim 21, wherein said idle signal transmission means contains switch time information for switching the

frequency channel to be used for the transmission of said idle signal and channel specifying information for specifying the channel to be used after the switch in said idle signal.

23. The radio communication device according to claim 21, further comprising:  
an information signal transmission means for transmitting an information signal to some other radio communication device; and

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said information signal transmission means contains switch information for switching the frequency channel to be used for the transmission of said idle signal and channel specifying information for specifying the channel to be used after the switch in said idle signal.

24 A radio communication device adapted to radio communications using a plurality of frequency channels, said device comprising:

an idle signal reception means for receiving an idle signal transmitted from some other radio communication device by using one of said plurality of frequency channels to notify the availability of said frequency channel;

an information signal transmission means for transmitting an information signal to said some other radio communication device, or the origin of said idle signal, according to the timing of receiving said idle signal; and

said information signal transmission means being adapted to transmit said information signal, using the frequency channel used for the transmission of said idle signal out of said plurality of frequency channels.

25. The radio communication device according to claim 24, wherein  
said idle signal contains channel limiting information for limiting the frequency  
channels that can be used for transmitting an idle signal out of said plurality of  
frequency channels; and

    said idle signal reception means performs a search operation only on the  
frequency channels limited by said channel limiting information.

26. The radio communication device according to claim 24, wherein  
said idle signal contains switch time information for switching the frequency  
channel to be used for the transmission of said idle signal and channel specifying  
information for specifying the channel to be used after the switch; and

    said idle signal reception means switches to the frequency channel specified by  
said channel specifying information when the time specified by said switch time  
information comes.

27. The radio communication device according to claim 24, further comprising:  
    an information signal reception means for receiving an information signal  
transmitted from some other radio communication device;

    said information signal contains information for switching the frequency  
channel to be used for the transmission of said idle signal and channel specifying  
information for specifying the channel to be used after the switch; and

    said idle signal reception means switches to the frequency channel specified by  
said channel specifying information when the time specified by said switch time

information comes.

28. A radio communication system comprising a base station and one or more than one terminal communication devices for radio communications between said base station and said one or more than one terminal communication devices, using a plurality of frequency channels;

said base station having:

an information signal detection means for detecting an information signal transmitted from said terminal communication device or any of said terminal communication devices;

an idle signal transmission means for transmitting an idle signal to said terminal communication device, using any of said plurality of frequency channels, to notify said terminal communication device of the availability of said frequency channel;

an interference wave signal detection means for detecting any interference wave signal being transmitted by way of any of said frequency channels; and

said idle signal transmission means being adapted to transmit said idle signal, using a frequency channel free from the detected interference wave signals, if any,

said terminal communication device or devices having:

an idle signal reception means for receiving said idle signal;

an information signal transmission means for transmitting an information signal to said base station, or the origin of said idle signal, according to the timing of receiving said idle signal; and

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said information signal transmission means being adapted to transmit said information signal, using the frequency channel used for the transmission of said idle signal out of said plurality of frequency channels.

29. The radio communication system according to claim 28, wherein  
said idle signal transmission means of said base station contains channel limiting information for limiting the frequency channels that can be used for transmitting an idle signal out of said plurality of frequency channels in said idle signal; and

    said idle signal reception means of said terminal communication device performs a search operation only on the frequency channels limited by said channel limiting information to receive said idle signal.

30. The radio communication system according to claim 28, wherein  
said base station further has an interference wave signal transmission pattern estimation means for estimating the temporal pattern of transmission of an interference wave signal on each of the frequency channels on the basis of the detected interference wave signal and said idle signal transmission means switches the frequency channel for the transmission of said idle signal on the estimated pattern so as to make said idle signal and the information signal transmitted from said some other radio communication device in response to said idle signal not overlap the transmission of said interference wave and transmits said idle signal;

    said terminal communication devices further has an idle signal reception means

for receiving said idle signal and an information signal transmission means for transmitting an information signal to said base station of the origin of said idle signal in response to the timing of reception of said idle signal; and

    said information transmission means being adapted to transmit said information signal, using the frequency channel used for the transmission of said idle signal out of the plurality of frequency channels.

31. The radio communication system according to claim 30, wherein

    said idle signal transmission means contains switch time information for switching the frequency channel to be used for the transmission of said idle signal and channel specifying information for specifying the channel to be used after the switch in said idle signal; and

    said idle signal reception means switches to the frequency channel specified by said channel specifying information when the time specified by said switch time information comes.

32. The radio communication system according to claim 30, wherein

    said base station further has an information signal transmission means for transmitting an information signal to said terminal communication devices and said information signal transmission means contains switch time information for switching the frequency channel to be used for the transmission of said idle signal and channel specifying information for specifying the channel to be used after the switch in said information signal; and

said terminal communication devices further have an information signal reception means for receiving the information signal transmitted from said base station and switches to the frequency channel specified by said channel specifying information when the time specified by said switch time information comes.

33. A radio communication method for radio communications between a base station and one or more than one terminal communication devices, using a plurality of frequency channels;

    said base station detecting any interference wave signal being transmitted by way of any of said frequency channels;

    said base station transmitting an idle signal, using a frequency channel free from the detected interference wave signals, if any, to notify said terminal communication device or devices of the availability of said frequency channel; and

    said terminal communication device or devices being adapted to transmit said information signal, using the frequency channel used for the transmission of said idle signal out of said plurality of frequency channels.

34. The radio communication method according to claim 33, wherein

    said idle signal transmission means of said base station contains channel limiting information for limiting the frequency channels that can be used for transmitting an idle signal out of said plurality of frequency channels in said idle signal; and

    said idle signal reception means of said terminal communication device

performs a search operation only on the frequency channels limited by said channel limiting information to receive said idle signal.

35. The radio communication method according to claim 33, wherein  
said base station estimates the temporal pattern of transmission of an interference wave signal on each of the frequency channels on the basis of the detected interference wave signal and switches the frequency channel for the transmission of said idle signal on the estimated pattern so as to make said idle signal and the information signal transmitted from said some other radio communication device in response to said idle signal not overlap the transmission of said interference wave and transmits said idle signal; and

    said terminal communication devices transmits said information signal to said base station, using the frequency channel used for the transmission of said idle signal out of the plurality of frequency channels.

36. The radio communication method according to claim 35, wherein  
said base station contains switch time information for switching the frequency channel to be used for the transmission of said idle signal and channel specifying information for specifying the channel to be used after the switch in said idle signal; and

    said terminal communication device switches to the frequency channel specified by said channel specifying information when the time specified by said switch time information comes.

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37. The radio communication method according to claim 35, wherein  
said base station contains switch time information for switching the frequency  
channel to be used for the transmission of said idle signal and channel specifying  
information for specifying the channel to be used after the switch in said information  
signal; and

    said terminal communication devices switches to the frequency channel  
specified by said channel specifying information to receive said idle signal when the  
time specified by said switch time information comes.

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